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Incidence of first and recurrent cellulitis and its relationships to physical therapy: An observational study

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Abstract

Background: There are no studies that examined the rate of patient referrals for physical therapy (PT) following cellulitis.

Objectives: To evaluate the incidence of cellulitis, the frequency of referrals to PT after a first cellulitis event and the relationship between recurrent cellulitis and receiving PT.

Methods: A cross-sectional study based on medical records of patients from registry of Maccabi Healthcare Services from one calendar year who experienced a first event of cellulitis or erysipelas. The main outcome measures were: A first cellulitis event, defined when no other event occurred in the previous two years and a recurrent event, defined when it ranged from one month to two years after the first diagnosis. Data included also demographic, lymphedema variables, antibiotic prescription, and referrals for PT.

Results: Of 468,434 records, 6,179 patients had a diagnosis of cellulitis (1.32%), 127 (2.05%) were referred to PT and 76 of them (59.8%) were actually treated. Recurrence of cellulitis occurred among 18.97% of the patients. There was no association between cellulitis recurrence and referral to PT.

Conclusions: The frequency of cellulitis and of patient referral to PT after the first event of cellulitis are low. There is probably underdiagnosis of cellulitis and of erysipelas. Lack of association between recurrence of cellulitis and referral to PT may be explained by low rate of referrals. Reasons for non-referral to PT and the efficacy of CDT in preventing recurrent cellulitis should be investigated in future studies.

Keywords: Cellulitis, Complete Decongestive Therapy, Erysipelas, Lymphedema

Introduction

One of the major risk factors for the development of cellulitis is lymphedema which makes the relationship between cellulitis and lymphedema inseparable (Al-Niaimi & Cox, 2009; Dalaet *et al.*, 2012; Morris, 2008) [1, 27]. It has been claimed that complete decongestive therapy (CDT), which is a common treatment for lymphedema, contributes to reducing the risk of recurrent cellulitis (Arsenault, Reilly, & Wisw, 2011) [4]. Hence, it is recommended that all patients diagnosed with cellulitis should be referred for evaluation, counseling or treatment by a physical therapist certified in CDT in order to reduce the risk of further morbidity (Al-Niaimi & Cox, 2009) [1]. However, to the best of our knowledge, there are no studies that examined the rate of patient referrals for PT following cellulitis.

Cellulitis and erysipelas: Cellulitis is a streptococcus or staphylococcal bacterial dermal infection affecting the skin's deep dermal (Morris, 2008; Erysipelas is also a bacterial dermal infection but affects the skin only (Bartholomeeusen, Vandenbroucke, Truyers & Buntinx, 2007) [5], and causes inflammation of the lymph vessels (Dalal *et al.*, 2012) [10]. Distinguishing the diagnosis between the two is inconclusive. Cellulitis can spread through the body through the vascular or lymphatic systems, causing systemic symptoms such as fever and multiple white blood cells (Morris, 2008; Bonnetblanc & Bedane, 2003). Cellulitis at the lower limb accounts for about 80% of infections (Simonsen *et al.*, 2006) [33].

Incidence: The annual incidence of cellulitis in the US was 2.46% at ages of 0-64, with a peak at 45-64 years, and 1.64% in the UK (Simonsen *et al.*, 2006) [33]. All European annual incidence of erysipelas was 0.19-0.24% (Chartier & Grosshans, 1990) [8]. Recurrence of cellulitis accounts for 10-30% of cases experiencing first event (Dalal *et al.* 2012) [10]. In two retrospective studies, 47% and 45% of patients experienced at least one recurrence of cellulitis (Inghammar, Rasmussen & Linder, 2014; Pavlotsky, Amrani & Trau, 2004) [14, 30]. Physicians generally recommend antibiotics to prevent recurring cellulitis, but there are no standard treatment criteria and the issue is controversial (Stevens *et al.*, 2014) [34].

Risk factors: One of the risk factor for the development of cellulitis in adult population is lymphedema (Chartier & Grosshans, 1990; Cox, 2006; Dalal *et al.*, 2012) ^[1, 9, 10]. In one study, 9% of people who were diagnosed with cellulitis had lymphedema as well and 10% had chronic edema (Mistry, Sutherland & Levell, 2019) ^[25]. In another recent study, the prevalence of cellulitis in patients with lymphedema was 12.6% with a recurrence rate of 56.6% (Rodriguez *et al.*, 2020) ^[32]. Other risk factors include venous insufficiency, diabetes, obesity, ulcers, trauma, and foot injury (Dalal *et al.*, 2012; Inghammar, Rasmussen & Linder, 2014; Mistry, Sutherland & Levell, 2019; Perello-Alzamora *et al.*, 2012) ^[1, 14, 25, 31]. Risk factors of recurrent cellulitis are unclear and there are very few studies that have examined this (Dalal *et al.*, 2012) ^[10]. It is estimated that these are the same risk factors as those of first cellulitis and especially lymphedema and local risk factors such as venous insufficiency, trauma, and fungus (Cox, 2006) ^[9].

Treatment: Cellulitis is usually a minor illness treated by family physicians within ambulatory clinics (Morris, 2008; Perello-Alzamora *et al.*, 2012; Rodriguez *et al.*, 2020) ^[1, 31, 32]. Dermatologists often report consultations with family physicians on patients with lower-limb cellulitis who have not improved after treatment or have developed a recurrence (Levell, Wingfield & Garioch *et al.*, 2004; Musette *et al.*, 2004) ^[29]. Adult patients with additional comorbidities often require hospital admission for intra venous antibiotics (Morris, 2008; Carratala *et al.*, 2003) ^[1, 7]. In Israel, 1,069 patients were hospitalized due to skin diseases and subcutaneous tissue during 2011, which accounted for 0.4% of all hospital admissions (Israel Ministry of Health, 2020). An adjuvant treatment method for antibiotic, in cases where lymphedema has also been diagnosed, is CDT. The treatment provided usually by physical therapists certified in lymphatic treatment, demonstrated a decrease in recurrence of cellulitis and a reduction in infections (Lasinski *et al.* 2012) ^[21]. The treatment includes guidance on skin hygiene, lymphatic massage, compression garments, and exercises to reduce edema (Armer *et al.*, 2013; International Society of Lymphology, 2009) ^[3, 15]. Complete decongestive therapy was found to be effective in the secondary prevention of recurrent cellulitis, maintain patient health over time, and ultimately reduce hospitalization and the cost involved (Arsenault, Reilly, & Wise, 2011) ^[4]. In another longitudinal study, with five-year follow-up, patients treated with CDT that included the use of compression stockings experienced a 20% reduction in erysipelas recurrence compared to those not treated (Vaillant, 2007) ^[36]. However, these studies are rare and include small groups of patients (n=11-20). Incorrect diagnosis and symptomatic treatment may lead to medical complications such as recurrent cellulitis, erysipelas, and chronic edema (Foldi & Foldi, 2006; Lawenda, Mondry & Johnstone, 2009; Perello-Alzamora *et al.*, 2012) ^[11, 22, 31]. There is no evidence that treatment of other risk factors such as diabetes, venous insufficiency, and foot fungus is effective in preventing recurrent cellulitis (Sullivan & de Barra, 2018) ^[35]. Despite the encouraging evidence of the efficacy of CDT, it is unknown to what extent patients with a diagnosis of

cellulitis are referred for this treatment. Possible consequences for non-referral may be the development of chronic edema, ulcers, and recurrence of infections (Al-Niaini & Cox, 2009; Arsenault, Reilly, & Wisw, 2011; Cox, 2006) ^[1, 4, 9]. Therefore, although the initial treatment of cellulitis and erysipelas is antibiotic, it is important to consider secondary prevention due to the high rate of recurrent events (Sullivan & de Barra, 2018) ^[35].

Evaluation of frequency of physician referrals to physical therapy (PT) for CDT should be the first step to examining the issue at hand. Furthermore, the relationship between PT after the first event and the recurrence of the disease should be examined. Thus, the aims of this study were to evaluate: 1. the incidence of cellulitis; 2. the frequency of referrals to PT after a first cellulitis event; and 3. the relationship between recurrent cellulitis and receiving PT. It was assumed that the incidence of cellulitis will be similar to that described in other countries, the frequency of referral to PT will be low, and that patients who were treated by PT will be less likely to experience recurrent cellulitis.

Methods

Design and setting

This observational study was based on medical records of patients diagnosed with first time cellulitis or erysipelas (upper and lower limbs). Data extraction was performed with the help of the Maccabi Healthcare Services Research Unit and the Morris Kahn & Maccabi Health Care Data Science Institute (MKM). Data did not include patients' identification information and ID numbers were recoded. The study was approved by the Maccabi Healthcare Services Ethics Committee (Number: 0070-17-BBL).

Subjects

The records of patients (all ages) insured by Maccabi Healthcare Services, Central District in one year, from January 1 to December 31, 2015 included 468,434 patients (Israel Ministry of Health, 2015). This year was selected as a representative year, to enable tracking the following two years after the first cellulitis diagnosis, for recurrent episodes. Records with additional diagnoses such as abscesses and nail fungus were excluded. Patients who underwent another cellulitis event after receiving the referral and prior to actual PT were excluded from Odds Ratio evaluation.

Procedure

Main outcome measures

A first cellulitis event was defined when no other event occurred in the previous two years. A recurrent cellulitis was defined as cellulitis in the range of one month to two years after the first diagnosis (McNamara *et al.*, 2007) ^[24]. Cellulitis was not considered a recurrence in case of changing treatment due to worsening condition in the following month.

Data extraction

In the first stage, all patients who met the inclusion criteria were identified in the system. Then, diagnoses of cellulitis and erysipelas were searched using ICD9 relevant codes. Dates of first and recurrent diagnosis, type of diagnosis, area

of expertise of the attending physician were specified and relevant demographic variables were collected. In order to locate an antibiotic prescription of any kind, we searched the actual purchase of antibiotics a month after the first event.

Physician referrals to the emergency room and to PT were included if provided during the following month after the first cellulitis event. This is the time set for the first cellulitis by the attending physician, and a window of time for the physician to provide all necessary referrals. The date of first PT visit and number of visits were also specified. A 180-day time was given after the first event to include a first PT visit which could have been delayed due to long waiting period.

Statistical analysis

T Test and Chi² tests were used to compare between continuous and categorical variables respectively. Odds Ratio between recurrence of cellulitis and PT was evaluated. A statistically significant difference was considered when P <0.05. The statistical processing was done in R x64 software 3.4.3 (Ihaka & Gentleman, 1996).

Results

Subjects

Out of 468,434 records, 10,040 patients were identified with diagnosis of a first cellulitis. After deleting records with irrelevant diagnoses, 6,179 patients (1.32%) remained (Figure 1). Patients' mean age was 40.5 ± 24.1, of whom 32.46% were aged 19-44. The 0-18 age group accounted for 23.73% of all patients (Figure 2). Older patients were referred to PT more often than younger patients and women more than men, although more men experienced cellulitis for the first time (Table 1).

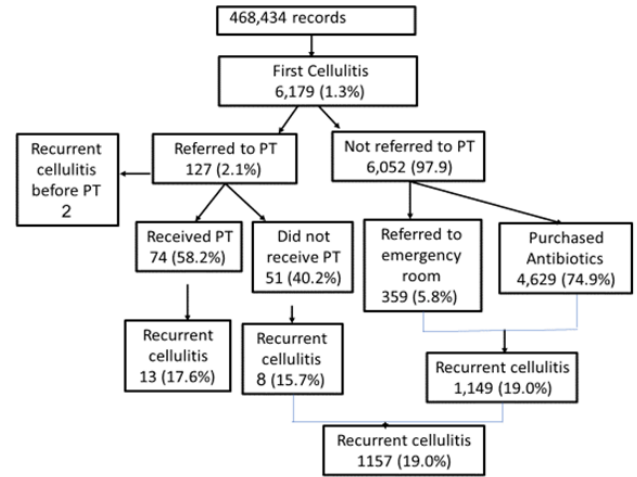


Fig 1: Flow chart

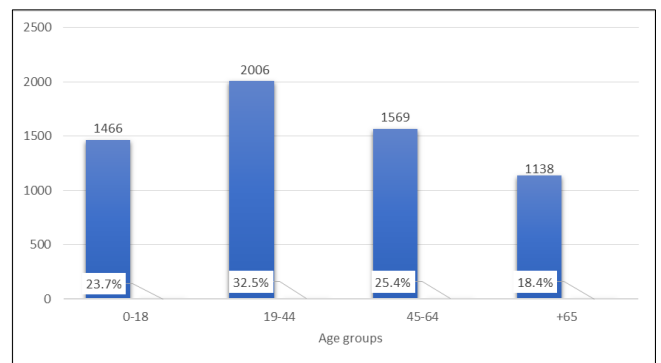


Fig 2: Frequency of cellulitis or erysipelas at different age group

Table 1: Participant characteristics*

Variable		Total	Referral to physical therapy		Sig.
			Yes	No	
N		6,172	127	6,052	
Age	Mean± SD	40.57 ±24.15	59.30±20.97	40.18 ±24.06	P<0.000
Gender	M	3,359 (54.3%)	53 (41.7%)	3,306 (54.6%)	P=0.005
	F	2,820 (45.7%)	74 (58.3%)	2,746 (45.4%)	
Lymphedema prior cellulitis		169 (2.7%)	8 (6.3%)	161 (2.6%)	P=0.027
Antibiotics		4,629 (74.9%)	90 (70.8%)	4,539 (75.0%)	P=0.337
Referral to emergency room		359 (5.8%)	15 (11.8%)	344 (5.6%)	P=0.006
Recurrent cellulitis		1,172 (18.9%)	23 (18.2%)	1,149 (18.9%)	P=0.9

*Numbers are n (% of total) unless otherwise mentioned

Incidence

Most diagnoses were of cellulitis (91.3%) and the rest of erysipelas (8.7%). In most cases (86.1%), the anatomic

region of the disease was not mentioned. Whenever it was mentioned (13.9%), the cellulitis appeared in the lower limbs (Table 2).

Table 2: Cellulitis and erysipelas annual incidence*

Variable		Frequency (N)	% of total with cellulitis and erysipelas	% of total population*
Total		6,179	100	1.3
Cellulitis		5,639	91.3	1.2
Erysipelas		540	8.7	0.1
Anatomic area	Unknown	5,322	86.1	
	Leg	857	13.9	

* 468,434 records of patients insured by Maccabi Health Services, Central District, 2015, Israel.

Patient's diagnosis and referral

Most primary diagnoses of cellulitis were performed by family physicians or by internal or general practitioners (Figure 3). Lymphedema prior to the first event of cellulitis was identified among 169 (2.7%) patients, of whom eight were referred to PT. Patients with lymphedema were more frequently referred to PT compared to patients without lymphedema. Lymphedema diagnosis was provided by physicians from various disciplines including general surgeons, family physicians, and general practitioners. Some of the lymphedema diagnoses were made by physical therapists (Figure 4).

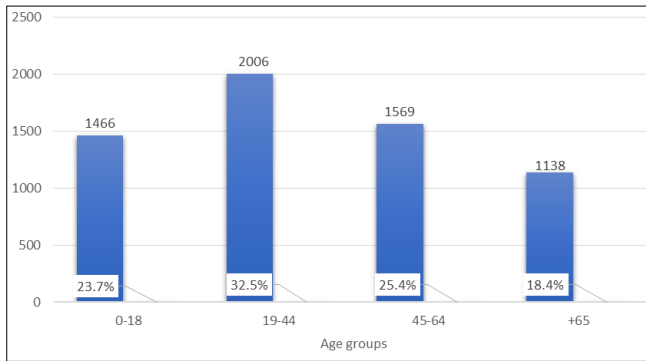


Fig 2: Frequency of cellulitis or erysipelas at different age group

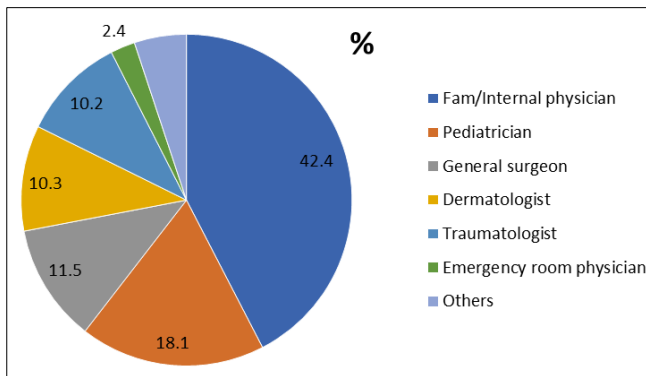


Fig 3: First cellulitis diagnosis

Treatment

A total of 4,629 (74.92%) patients purchased a prescription for antibiotics, 359 (5.81%) were referred to emergency rooms, and 127 (2.05%) were referred to PT after the first diagnosis. More referrals to PT were detected among those referred to emergency rooms. No association was found between purchasing antibiotics and referral to PT. Of patients referred to PT, 76 (59.8%) received actual treatment. Four patients in the 0-18 age group were referred to PT and two of them were actually treated. The average number of days between referral to PT and receiving treatment was 26 days (range: 28-128).

Recurrent cellulitis

Recurrent cellulitis was reported in 1,172 patients (19.0%). The time between diagnosis of first cellulitis and the date of recurrent cellulitis ranged between 1 to 24 months. Twenty-three (1.96%) patients who experienced recurrent cellulitis were referred to PT and there was no association between recurrent cellulitis and PT referral. Two patients experienced recurrent cellulitis after referral to PT and prior to receiving the actual treatment. The odds for recurrent cellulitis were

similar among those who received or did not receive PT (OR = 1.09) (Table 3).

Table 3: Odds Ratio for recurrent cellulitis with no physical therapy

		Recurrent cellulitis		Total	Odds Ratio
		Yes	No		
Physical therapy	Yes	13	61	74	1.1
	No	1157	4946	6103	
Total		1170	5007	6177	

Discussion

This is the first study that examine the rate of patient referrals for PT following cellulitis. The incidence of cellulitis and of erysipelas in this study was lower than that described in previous studies and frequent among all age groups including children and young adults. The results confirm the assumption that the rate of patient referral to PT after a first cellulitis event is very low. However, in the absence of studies on this topic it cannot be compared to other countries. Unlike our initial assumption, the Odds Ratio between recurrent cellulitis and receiving PT was negligible.

Incidence and referral

The annual incidence of cellulitis and erysipelas, in this study, was 1.2% and 0.11% respectively, which is lower than the incidence of cellulitis (2.46% and 1.64%) and erysipelas (0.19-0.24%) in the US and UK (Simonse *et al*, 2006). A possible explanation for the relatively low incidence of cellulitis at the present study is incorrect or under-diagnosis of cellulitis and erysipelas by community doctors as was previously suggested (Perello-Alzamora *et al.*, 2012) [1]. In addition, some cases of skin disease may mimic cellulitis and are difficult to diagnose, especially for non-dermatologists (Arakaki, Strazzula, Woo, Kroshinsky, 2014) [2]. In that study about 33% of cellulitis cases were defined as error in clinics. The authors suggested that the diagnosis of dermatologists who are experts in inflammatory infectious skin diseases, may be more accurate. Accurate diagnosis can reduce antibiotics and referrals for hospital admissions. However, in another study the researchers concluded that cellulitis diagnosis should be done by infectious physicians who are more accurate and reduce referrals to hospital (Jain *et al.*, 2017) [19]. In the present study, family, internal and general practitioners provided most of the diagnoses of cellulitis for the first time. The proportion of dermatologists in the diagnosis of cellulitis was small and no diagnosis was made by an infectious disease specialist.

Cellulitis and age

Another important point is the inclusion of patients with no age restriction in this study. In two previous studies, the incidence of cellulitis was found to increase with age (Perello-Alzamora *et al.*, 2012; McNamara *et al.*, 2007) [1, 24]. In contrast, in a study that also included young patients, but excluded adults over the age of 65, most cases of cellulitis were in the 0-19 age group (41.9%) (Simonsen *et al.*, 2003) [33]. In that study, the percentage of patients with cellulitis among the age groups of 20-44 and 45-56 were 31.6% 26.5%, which is similar to the findings of the present study. Obviously, as cellulitis can appear at any stage in life it should be examined at all age groups. Presumably, the likelihood of referral increases when it comes to an adult with

a variety of background illnesses and with a fear of further complications (Arsenault *et al.*, 2011) [4]. However, in this study, of 1,466 patients in the 0-18 age group, only four were referred to PT. In our experience, young patients can benefit from CDT to prevent recurrent cellulitis and associated complications more than adults. Therefore, it is important to further investigate the efficacy of CDT as a treatment of cellulitis and erysipelas also among young patients.

Cellulitis and gender

As expected, more men experienced a first event of cellulitis than women as described previously (Inghammar & Rasmusseb, 2014; Moffatt, Franks, Burbidge, Wallace & Lam, 2006; Simonsen *et al.*, 2006) [14, 26, 33]. However, more women were referred for PT. Of those referred, the proportion of adults was greater compared to the younger patients.

Treatment

About three-quarters of the patients in this study purchased antibiotics which is similar to the results of a previous US study (69%) (Hersh, Chambers, Maselli, Gonzales, 2008) [12]. The authors of that study claimed that the decline in antibiotic referrals is due to an increase in complications and in resistance to antibiotics. It is assumed that physicians in Maccabi healthcare services, similar to their colleagues in US, do not prescribe antibiotics routinely for any diagnosis of cellulitis.

The referral rate for PT in this study was very low despite some evidence of the efficacy of CDT in preventing recurrent cellulitis or erysipelas

(Arsenault *et al.*, 2011; Vaillant, 2007) [4, 36]. This may be due to physicians' lack of awareness of the CDT offered at the HMO by physical therapists or to its potential efficacy in the prevention of recurrent cellulitis. However, reasons for non-referral to PT were not examined and should be studied in future research. A minority of patients (5.8%) were referred to the emergency room; Of these patients more were also referred to PT compared to patients who were not referred. Presumably, these are patients with a more severe cellulitis that required referral for both emergency room and PT.

Cellulitis and lymphedema

Only 2.74% of the patients with cellulitis had also diagnosis of lymphedema. It is often mentioned that lymphedema is a major risk factor for cellulitis (Keeley, 2008; Sullivan & de Barra, 2018) [20, 35] and recurrent cellulitis (Inghammar, *et al.*, 2014; Pavlotsky *et al.*, 2004) [14] and therefore a higher percentage of patients with both diagnoses was expected. In addition, only eight of the patients with a combination of cellulitis and lymphedema were referred to PT. This number is very low compared to the results of a survey conducted among 1,449 patients with lymphedema in England (Moffat *et al.* 2006). In that survey, family physicians referred about two thirds of oncology patients and about half of non-oncology patients to CDT. The authors raised the difficulty in treating patients with lymphedema and directing them to appropriate caregivers in England. According to the present study, there may be both under-diagnosis of lymphedema and under-treatment among patients with diagnosis of cellulitis.

Recurrent cellulitis and complete decongestive therapy

Recurrent cellulitis appeared between one to two years after the first event in 18.97% of the cases. This number is within

the range of recurrent cellulitis (10-30%) described previously (Dalal *et al.* 2012) [10]. Among patients who experienced a recurrent event, only 23 were referred for PT after the first event.

However, the assumption that there is an association between receiving PT and the development of a recurrent cellulitis has not been verified in the present study. These results should be discussed cautiously because referral percentage and the actual arrival rate for lymphatic treatment were low. Given the recommendations to refer patients with cellulitis to CDT (Armer *et al.*, 2014; International Society of Lymphology, 2009; Lasinski *et al.*, 2012) [3, 15, 21], more referrals should have been expected. In practice, only 60% of the patients who were referred to PT actually received the treatment. The non-arrival may be related to long waiting time for PT and probably for lack of proper explanation by the physician as to the importance of this treatment.

Generalizability

An important strength of this study is the representative potential of its population. Although patients' records were obtained from one district during one year it is assumed that they are similar to trends in previous years since guidelines for the diagnosis and treatment of cellulitis have not been changed over the years. The potential generalization of this population may also be supported by similarities of some characteristics of the present study population and that reported in previous studies. However, patients' characteristics from different districts may differ and, therefore, this issue should also be evaluated in other districts of Maccabi and in other HMOs in the country.

Limitations

The reasons for non-referral to PT by physicians and for non-arrival to PT were not evaluated. Possibility, some patients were referred by physicians to PT after the first month following cellulitis or recurrent cellulitis; these cases were not included in the study. Also, it was not possible to determine if the referral given by the physician was intended for lymphatic or other PT treatments. Our working assumption was that if and when physician referral was provided a month after cellulitis diagnosis, the referral is related to the active problem. Finally, the lack of association between PT and recurrent cellulitis may be due to the small number of patients referred to PT.

Implication on physiotherapy practice

Physical therapists should be aware of their potential role in the treatment of patients with cellulitis or recurrent cellulitis. They are encouraged to discuss this issue with fellow physicians in order to raise their awareness of the link between cellulite and lymphedema and of treatment options. It is important that research physiotherapists promote exploratory studies in the field to establish the information that exists today.

Conclusion

The frequency of cellulitis and lymphedema among the sample of this study is slightly lower than that described in the literature and may indicate an under-diagnosis of the disease. Given the close relationship between recurrent cellulitis and lymphedema, more patients with lymphedema diagnoses and more referrals for PT are expected. Therefore, further investigation into the reasons for these results is

needed. At the same time, the efficacy of lymphatic treatment in the prevention of recurrent cellulitis should be examined in a randomized clinical trial.

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